The Future of Single-Cell Applications:

Discussing the Importance of Bringing Single Cell Function into Focus with the Envisia Platform from Lightcast

1. Can you please start by providing a brief overview of Lightcast's history and how the company has developed since being founded?

The foundational technology of Lightcast is actually spun out from Base4, an early stage Cambridge-based company that was initially working with optical-electrowetting (oEWOD) technology for DNA sequencing. However, it became clear there was potential for cell-based assays, including single-cell applications, which at that point, focused largely on static molecular profiles.

And so Lightcast was founded in 2019 to further develop a version of oEWOD that enables precise manipulation, tracking and functional characterisation of cells at single-cell resolution. In late 2023, we launched the Luminary Early Access Program. In May 2024, we then opened the Boston Innovation Centre to support the expansion of that program and in May 2025, we revealed the Envisia platform to the world at PEGs Boston.

2. Lightcast take a function-focused approach to their work. Please explain what this means and how it differs from other offerings.

In many drug discovery programmes, functional analysis is performed relatively late in the pipeline and often after early candidate pools have already been filtered using molecular or binding data alone. The problem is that those screens are inherently indirect; a strong binder or a promising transcriptomic profile doesn't always translate into the cell behaviour that drives therapeutic effect. By the time researchers get around to functional assays, the most potent clones, for example that rare antibody that blocks and recruits or the T cell with true serial killing capacity, may already have been discarded.

Lightcast is aiming to shift this dynamic. Envisia enables functional readouts like secretion, binding, cytotoxicity at the single-cell level, and does so in a multiplexed, sequential and traceable way. That means researchers can generate a direct functional fingerprint for each cell while still recovering it for sequencing and re-expression or outgrowth. In practice, it ensures that high-performing candidates aren't lost in the noise and that functional data drives decision-making from the very start.

3. Please explain more about the technology that is on offer from Lightcast.

Previewed earlier this year, Envisia integrates oEWOD, droplet microfluidics and machine learning (ML) into a benchtop system that makes functional single-cell analysis practical for any lab.

Core Technology

Droplet-based compartmentalisation: using a gentle step-emulsification, cells are encapsulated in picolitre droplets, preventing crosstalk and ensuring accurate readouts.

oEWOD manipulation: light-driven control allows droplets to be moved dynamically, merged as required to build assays and workflows, and then dispensed off-platform in real time based on user-defined criteria. This enables highly flexible workflows that adapt to evolving research needs.

ML filtering: after the initial droplet generation, real-time algorithms overcome inefficiencies in random droplet loading. In typical systems, only around 27% of droplets contain the desired contents, compared with 95% occupancy achieved by Lightcast using this ML-based filtering.

Traceability: each droplet, its contents, interactions and readouts are tracked, from load to dispense. This enables

researchers to link functional performance on-platform to off-platform analysis, such as sequencing.

The result is a system that not only captures the functional diversity of single cells but also lets researchers rapidly recover the exact ones they want to take forward.

4. How do you see Envisia impacting drug development?

Envisia creates a fully traceable environment in which individual cells can be isolated, paired with reagents or other cells, assayed and ultimately recovered. For drug developers, this means the ability to rapidly screen immune cells, antibody-producing cells, or engineered cell therapies for the functions that matter most, not just binding, but killing, persistence and serial activity. And we can run these interactions sequentially, building increasingly complex functional workflows. We can then take hits off-platform for further analysis, such as sequencing and re-expression, or perhaps transcriptomic analysis, thus generating a more comprehensive view of each hit. This should lead to better candidate selection, reduced attrition and faster progression from discovery into development.

5. Why is single-cell functional analysis critical to the drug development process?

Drug development ultimately comes down to how cells behave, whether an antibody blocks a pathway or enhances it, whether a T cell actually kills its target and whether a therapy persists long enough to matter in a patient. Yet, across the industry, bulk assays are still the default way of measuring these effects. They give you an average signal across millions of cells, which can be useful, but you risk missing the top performing candidate.

That's where single-cell functional analysis makes the difference. Instead of averaging, it lets researchers see exactly which individual cells are driving the activity and in what way. You can find that subset of T cells with serial killing capacity or the antibody-producing cells that not only bind but trigger the right downstream effect. This is especially critical in areas like antibody discovery, ADCs and cell therapies, fields where function is the ultimate predictor of whether a treatment will succeed in patients. By moving beyond bulk assays and looking directly at function one cell at a time, researchers gain a level of clarity and precision that simply hasn't been possible before.

6. Please can you provide a brief insight into what the drug development market currently looks like and why the work being done by Lightcast is so important?

The industry is under immense pressure; development timelines are long, costs are high, and success rates are lower than anyone would like. At the same time, new therapies like cell and gene therapies show huge promise, but they require a new type of toolkit to really uncover how they behave. Again, that's where we see Lightcast's value. By helping researchers measure what cells do, not just what they are, we're giving them a way to make better decisions earlier. That can save time, money and ultimately help patients faster.

7. Please can you explain what the key markets being targeted by Lightcast are and why these areas have been identified?

Right now, our main focus is on antibody discovery, ADCs and cell therapies. In these markets functional analysis is now seen as essential. An antibody might bind beautifully, but if it doesn't trigger the right response, it won't make it as a drug. Cell therapies are even more complex, as you need to know if a T cell can persist, kill and sometimes even kill again. Those are exactly the kinds of questions Envisia was built to answer.

8. How are Lightcast able to work collaboratively with other companies to accelerate drug discovery research?

We see collaboration as a natural part of what we do. Our technology slots into existing workflows, so researchers can generate functional data on Envisia and then combine it with sequencing, imaging or re-expression. We've also set up early-access programmes that allow us to work closely with partners to explore new applications. It's mutually beneficial; we learn from their biology and they get to push the limits of our platform. We are currently working with a number of big pharma companies who, for obvious reasons, we cannot disclose. But we also have instruments with several key academic sites in both Europe and the US.

9. Please provide us with a brief insight into what's to come next for Lightcast.

As the Autumn conference season gets up and running, we'll be out providing updates. We're already working on expanding the menu of assays researchers can run, so they can explore everything from antibody binding to cell killing on the same platform. We're also continuing to build out partnerships with pharma and biotech groups worldwide. We firmly believe that Envisia has the potential to become the de facto standard for functional single-cell biology!

Jonathan Didier

Jonathan Didier, PhD, is the Field Application Team Leader at Lightcast. He previously worked for Berkeley Lights, Inc. He received his PhD from Carnegie Mellon University and did postdoctoral work at Harvard University's Wyss Institute, focusing on clinical applications of droplet microfluidics.